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with any necessary attachments,
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PLEASE KEEP A COPY FOR YOUR RECORDS

INVENT

Exhibit "A"

NOV 16 2002

ORLANDO INTELLECTUAL
PROPERTY DEPARTMENT

Page 1 of 4

OR IPD USE ONLY

Division/Dept Code

Cost Center Code 3525/CTB

Docket No. 2002E1919448

IP Attorney MUS

1. Your Div.'s Project # (i.e. 6-number) SZ100153ZA01; Invention Title Synthesis and Application of Novel, Low-melting Ceramic Systems for the Repair of Thermal Barrier Coatings on Gas Turbine Components

2. INVENTOR

At the time the invention was conceived, this inventor was
☐ an employee of a German legal entity (e.g. Siemens AG)
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Date 11/17/2002

3. CO-INVENTOR (if any)

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Date 17 Nov. 2002

4. Purpose(s), and likely field(s) of use of this invention This invention is to be used in the field of Gas Turbine Service & Repair for the purpose of repairing spalled/damaged TBC's on service-run Gas Turbine Components

5. Is this invention still secret within Siemens? YES ☐ NO ☒

Do you soon plan to make the invention information available outside of Siemens? YES ☐ NO ☒

Based on your answer to Question #5, explain when and how this invention was/will be made available to someone outside of Siemens (e.g. trade show at location/date, customer presentation at company/location/attendees/date, supplier prototyping by company/date, included in product brochure or advertisement in publication/date, industry technical symposium paper presented place/date, etc)

6. Where is this invention described? List all documents containing aspects of this invention (e.g. engineer notebook date/page, internal status report, test logs, physical prototypes, customer presentation, etc) Engineer note-book # 6 (5/16/02), Engineer's R&D Journal (6/26/02), Quarterly Program Reviews (9/4/02 and 10/29/02)

7. What date do you recall creating this invention? 5/16/02

When do you recall first explaining this invention to a witness who is not also a co-inventor? 5/16/02

Who was those witness(es)? John Musone

Has this invention been prototyped or tested yet? If so, when, where, by who? What were the results? The concept of using low-melting ceramic compositions for TBC repair has been tested, but the design and synthesis of new ceramic systems has not been tested. The conceptual testing using commercial ceramics was performed by the inventor at the SWPC Casselberry Engineering Labs on 6/3/2002. The results were encouraging.

8. I have ☒ have not ☐ attached 1 number of additional sheets to better describe this invention.

9. Identify all non-Siemens companies that may in the future benefit from the use of this invention through a license.

10. Was this invention developed under, or quoted for, a customer contract? YES ☐ NO ☒

11. Was it developed under a government contract? YES ☐ NO ☒

If yes to either, please give contract name and number, and further explain the situation

IF THE ANSWERS TO ANY OF THESE QUESTIONS CHANGE BEFORE THIS INVENTION IS FILED AS A PATENT APPLICATION WITH THE GOVERNMENT, MAKE SURE TO SEND AN UPDATE TO SIEMENS IPD.

12. WITNESSED AND UNDERSTOOD BY:

Signature [Signature]

Name Zafar Akbar

Date 11/18/02

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General

- PLEASE TYPE OR PRINT CLEARLY. Answer all questions. Use N/A when not applicable.
- Sign and date each page in ink.
Sign and date all attached additional sheets, diagrams, photographs, etc
Please provide all of your given names in full in sections 2 and 3. When there are more than two inventors, use another form and complete and sign items 1, 2, 3 and 10 on the extra forms.
- Every page of the form and accompanying papers should bear the signature of a witness and the date of his/her signing. The witness should have read the forms and attached papers, and should understand the invention before witnessing. The witness should have a technical background related to the invention, to reduce the chances that someone can later challenge his/her ability to have understood the invention.
- A co-inventor should not be the witness. If you have a choice of several qualified witnesses, choose the witness you believe is most likely to still be a Siemens employee available in this country if a question comes up several years from now. That means you should avoid having a co-op student, contract engineer, or a retiring engineer serve as your witness.

Detailed Description

- The description you provide may serve as the basis for a patent application. Therefore, be as complete and as accurate as possible. Attach pages as necessary, using the following checklist as a guide for content.
 - **Abstract:**
In one or two sentences, briefly describe what your invention does and how it is used, e.g., "A voltage-controlled oscillator (VCO) has its period controlled by a current provided by a current source. The current is proportional to the reciprocal of a control signal so that the VCO frequency is directly proportional to the control signal."
 - **Background Information:**
What is the function of your invention?
What is the problem solved by your invention?
How was the function of your invention performed by any prior systems, either a competitor's or ours?
What are the disadvantages of these prior systems?
What are the advantages of your invention over them?
 - **Details:**
Describe in detail the structural and functional operation of your invention. Use drawings and graphs where they would be helpful. Give specific details, not just general information.
Point out things such as what improvements your invention incorporates, or how and why it achieves superior performance (if you know why).
Are there alternative methods or different structural embodiments of your invention?
Can the general idea or technique of your invention be extended to other related fields? How?
Which features are believed to be new?
Describe how you best envision your invention being put to use.

Related Art

Attach a copy (or bibliographic citation) of all publications, patents, etc. that you know about which relate to your invention, and which you think might be important to consider in understanding how your invention differs from prior work.

Potential Licensing Opportunities

Please identify, in relation to item 9, all companies that are not a part of Siemens and may benefit, in the future, from the use of this invention. This will be helpful in identifying potential licensing opportunities for this invention.

REMEMBER TO UPDATE THE IPD IF ANY OF THE INFORMATION YOU PROVIDED CHANGES.

**X Yes, I promise I will update the Siemens Intellectual Property Department (IPD)
if any of the information I've provided changes**

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Invention Title:

The Synthesis and Use of Novel, Low-melting Ceramic Systems for the Repair of Thermal Barrier Coatings on Gas Turbine Components

Abstract:

This invention disclosure describes the synthesis of Novel, Low-melting ceramic systems that can be applied as a repair coating via thermal spray processes such as Flame Spray, Plasma Spray. The objective of this invention is to apply these novel ceramic coatings onto the spalled/damaged areas of a Thermal Barrier Coating, thereby enabling an "in-frame" repair of service-run Gas Turbine Components.

Background Information:

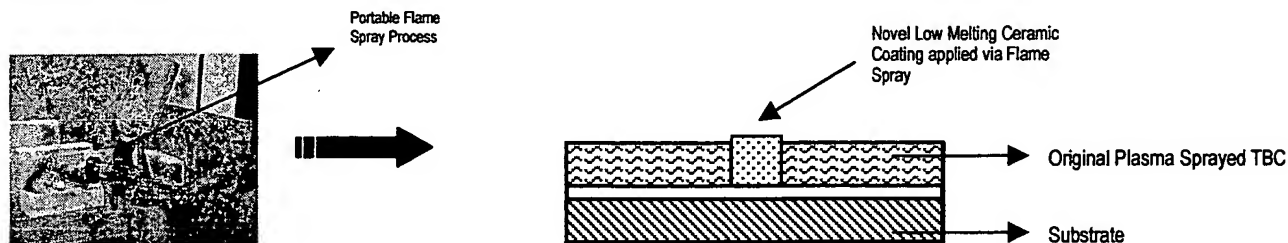
Thermal Barrier Coatings (TBCs) on Gas Turbine Hot Section components are typically damaged in the course of service operation. These TBCs experience localized spallation typically caused by a variety of factors that include, bond-coat oxidation and thermal stress caused by over-temperature, thermo-mechanical fatigue of the coating, erosion and impact caused by particulates in the hot gases flowing over the coating, etc. The repair of these spalled regions, even if the repairs provided limited added life (4000-8000 service hours), can drive significant cost savings in the field of service & repair, especially, SWPC's long-term service contracts. The magnitude of these savings can be greatly increased if these repairs can be performed within the engine itself (in-situ) without moving to a full "hot gas-path inspection" that would require a "cover-pull" and significant cost to SWPC.

Description of Invention:

This invention proposes the synthesis and use of novel ceramic compositions with low melting temperatures as a means to realize the "in-situ" nature of the proposed repair. These low melting ceramic systems can be applied onto the damaged areas of the coated (TBC) components via a Flame Spray Process (figure below) or other similar coating processes. The Flame Spray Process provides the significant advantage of being portable and conducive to "in-frame" use. Currently available low-melting ceramic coatings that are flame sprayed are presented in U.S. Patent No 4,588,655.

This invention proposes new coating systems with low melting that are superior to the Zirconia + Alumina coating described in the above-mentioned patent. In addition to the new compositions, this invention also proposes advanced processing methods (different from those listed in the prior patent), namely "wet-chemical methods" that provide powders with improved compositional homogeneity. The new compositions when coupled with the "wet-chemical" method of processing are expected to produce coatings with greatly improved deposition characteristics and elevated temperature properties.

The novel compositions that are being proposed include chemically homogenous mixtures of ***Yttria Stabilized Zirconia (YSZ) and Calcium Titanate, YSZ + Calcium Zirconate, YSZ + Strontium Zirconate, YSZ + Strontium Titanate, and other similar mixtures containing ceramic oxides.*** These ceramic compositions can be synthesized via ***"wet-chemical methods" that include Sol-Gel Processing, Co-precipitation and Micro-emulsion processing.***



Inventor's Signature: _____

Witness' Signature: _____

Date: _____

Date: _____

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**SUPPLEMENTAL SHEET
FOR INVENTION DISCLOSURE**

Page 4 of 4

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Date: _____

Witness' Signature: _____

Date: _____

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